REMARKS

Claim Rejections Under 35 USC §103

Claims 24-36 have been rejected under 35 USC 103(a) as being unpatentable over the admitted prior art (APA) in view of Lee et al. (U.S. Patent No. 5,796,586), Akram et al. (US Patent No. 5,739,585) and Hoffman et al. (US Patent No. 5,360,942).

The rejections under 35 USC §103 are traversed for the reasons to follow.

Summary of the Invention

The claims are directed to a board-on-chip semiconductor package 62 (Figure 6B). As shown in Figure 6B, the BOC package 62 includes a substrate 56 comprising a first surface 44 with a pattern of conductors 48, an opposing second surface 46 with a die attach area 50, and a wire bonding opening 64 extending through the substrate 56 from the first surface 44 to the second surface 46. In addition, the package 62 includes a first solder mask 80A having openings 82 for attaching solder balls 88 to the conductors 48, and an opening 84 (Figure 3C) for wire bonding to the conductors 48. The package 62 also includes a second solder mask 80B having an opening 86 (Figure 3D) on the die attach area 50.

As also shown in Figure 6B, the package 62 includes a semiconductor die 16 placed face down (circuit side down) through the opening 86 in the second solder mask 80B, and attached directly to the substrate 56 in the die attach area 50. An adhesive layer 72 (Figure 6A) attaches the face of the die 16 directly to the substrate 56. The package 62 also includes wires 94 placed through the wire bonding opening 64 in the substrate 56, and bonded to bonding pads on the face of the die 16, and to bonding pads 52 (Figure 6A) on the conductors 48. In addition, solder balls 88 are placed through the openings 82 in the first

solder mask 80A, and attached to ball bonding pads 54 (Figure 6A) on the conductors 48. As also shown in Figure 6B, an encapsulating resin 90 is molded over the die 16, and over the second solder mask 80B. Further, a glob top 92 can be placed over the wires 94, and in the wire bonding opening 64 to protect the wire bonds.

Argument

The rejections under 35 USC §103(a) are traversed, as the Examiner has not established a prima facie case of obviousness. In this regard MPEP 2142, 2143 set forth the three basic criteria for establishing a prima facie case of obviousness under 35 USC §103(a). First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success in obtaining the claimed invention based upon the references relied upon by the Examiner. Third, the prior art reference (or references when combined) must teach or suggest all the claim limitations.

However, there is no suggestion or motivation in the references, or in the art, to combine the references in the manner of the Office Action. The Office Action combines the references by stating: "Therefore, it would have been obvious to a person of ordinary skill in the art at the time invention was made to use a second mask having an opening and a second outline corresponding to but only slightly larger than the first outline so that the die is bonded directly to the second surface using a filled adhesive so that the bonding and heat transfer from the chip to the substrate can be improved and the cracking of the solder mask can be prevented using Lee et al., and Akram et al. and Hoffman's bonding structure in the admitted prior art."

The teaching on the "cracking of the solder mask" apparently comes from column 7, lines 58-63 of Lee et al. wherein it is stated: "Generally, these solder masks are lower cost and offer higher performance since they are more resistive to cracking at a location under substrate board 200 than their expensive "highly adhesive" counterparts. In addition, the solder mask material is resistive to cracking even after autoclave (pressure cook) tests."

The "resistance to cracking" is a function of the solder mask material, which as described at column 7, line 56, of Lee et al. is polyimide, and has nothing to do with an open die attach area as in the present package. Further, Lee et al. teaches at column 7, lines 64-65 that the polyimide solder mask material "may be a liquid photo imagable (LPI) material." The solder masks 20A, 20B of the APA package 10 of Figure 1A are already an LPI material (page 3, lines 31-34 of the present specification), such that there would be no reason to combine Lee et al. with the APA package to provide improved cracking resistance.

In addition, Lee et al. does not teach that bonding of the die to the substrate provides "a better resistance against cracking at the substrate surface", as stated at page 4, lines 2-3, of the Office Action. Rather, the main focus of Lee et al. is to provide good adhesion between the encapsulant and the board, while facilitating the removal of excess encapsulant from the gate area (column 2, lines 59-64). Accordingly, there is no specific improved bonding teaching in Lee et al. as suggested by the Office Action, and no motivation to combine Lee et al. with the APA package.

The Office Action further states that Akram et al. teaches face bonding "using typical/fill materials" (col. 4, line 26). However, there is no mention of filled adhesives in Akram et al. In this regard, independent claims 24 and 27 have been amended to emphasize the face bonding of the die in the present package. Although Shim

et al. and Hoffman et al. teach filled epoxies to improve heat conductivity, both of these references teach back bonding of the die rather than face bonding as presently claimed. Accordingly, one skilled in the art at the time of the invention would have no motivation to apply the filled epoxy teachings of these references to the face bonding construction of the APA package.

Finally, in combining references Applicants would ask the Examiner assess the claims "as a whole" from the viewpoint of one skilled in the art at the time of the invention. As stated in Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 730 F.2d 1452, 221 USPQ 481 (March 21, 1984), "the claimed invention must be considered as a whole, and the question is whether there is something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination."

Conclusion

In view of the above arguments and amendments, favorable consideration and allowance of claims 24-36 is respectfully requested. Should any issues arise that will advance this case to allowance, the Examiner is asked to contact the undersigned by telephone.

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September 19, 2002
Date of Signature

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Marked Version Of Amended Claims Showing Changes

24. (five times amended) A semiconductor package comprising:

a substrate comprising a first surface, a second surface, a plurality of conductors and ball bonding pads on the first surface, and a bonding opening from the first surface to the second surface;

a semiconductor die having a first outline and a face on the bonding opening bonded directly to the second surface;

a first mask on the first surface comprising a plurality of via openings aligned with the ball bonding pads;

a second mask covering the second surface except in a die attach area defined by an opening through the second mask having a second outline corresponding to but only slightly larger than the first outline;

an adhesive layer between the [die] face and the substrate in the die attach area bonding the [face] die to the second surface;

a plurality of wires placed through the bonding opening and wire bonded to the die and to the conductors; and

an encapsulating resin on the die and on the second mask.

27. (five times amended) A semiconductor package comprising:

a substrate comprising a first surface, a second surface, a plurality of conductors on the first surface comprising ball bonding pads and wire bonding pads, and a bonding opening from the first surface to the second surface;

a semiconductor die having a first outline, the die comprising a face on the bonding opening bonded to the second surface;

a first mask on the first surface comprising a plurality of via openings aligned with the ball bonding pads and a first opening exposing the wire bonding pads;

a second mask substantially covering the second surface comprising a second opening having a second outline corresponding to but only slightly larger than the first outline to define an open die attach area on the second surface;

a filled adhesive layer between the [die] face and the substrate in the open die attach area bonding the [face] die to the second surface and transferring heat directly from the face to the substrate;

a plurality of wires in the bonding opening wire bonded to the die and to the wire bonding pads; and

an encapsulating resin on the die and on the second mask.